

Digital agriculture as part of an innovative economy

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Abstract— Agriculture has already become a sector with a very large flow of modern information data. Russian farmers and agronomists now have access to mobile applications that provide accurate recommendations and a sequence of actions in their work. So far, only about 14 % of Russian agricultural enterprises use elements of digitalization in their farms, introduce scientific and technical developments. In 2018, the Ministry of agriculture launched the state information system for seed tracking. This program will help to reduce the market of low-quality seed products, reaching today up to 40 % of marriage, and improve the quality of seeds. Now not all farmers can use advanced technologies and solutions. But the tools of digitalization will gradually become cheaper, and this will make their use mass.

Keywords—*digitalization of agriculture, innovative economy, information technologies, agricultural enterprises, scientific developments.*

I. INTRODUCTION

Agriculture in the country now can not be called an innovative industry, but there are certain changes taking place here, of course. These are biotechnologies, nanotechnologies, improvement and creation of new varieties of crops and improvement with the help of methods of genomics of animal breeds. Now the market of agricultural products is working on the needs of segmentation of consumers. Digital technologies play an important role in this.

So far, the use of digital economy technologies in rural areas is very low. Heads of agricultural enterprises also do not pay much attention to information technologies.

Russia ranks 45th in the world in terms of the use of information technologies in agriculture. Approximately 14 % of Russian agricultural enterprises have the opportunity to apply elements of digitalization in their farms, to implement scientific and technical developments.

II. LITERATURE REVIEW

The problems of introducing digitalization in agriculture were considered by A. A. Aletdinova in the article "Innovative development of the agricultural sector on the basis of digitalization and creation of technological platforms", which refers to the possibility of creating technological platforms at the present time. Kolomeyenko, A. S. in the article "Information support of innovative development of agriculture" asserts the necessity of information support of the agrarian sector of the country. Lovchikova E. I., First N. Ah. Malting A. I. in the article "Digital economy and human resources potential of agriculture: strategic relationship and prospects" prove the need to improve the level of knowledge of personnel in the

agricultural sector. Litvinov F. I. in the article "Sustainable socio-economic development of agriculture in the conditions of Russia's entry into the era of the digital economy" considers the possibilities of the agricultural sector to reach the modern level of digitalization. Romanenko I. A., Evdokimova N. E. in the article "Information and analytical system to support the tasks of forecasting the development of regional agro-food systems" define the range of tasks for the development of forecasting at the regional level. Saitov R. N. in the article "Digital economy in agriculture" focuses on the development of digitalization in agriculture as a necessary condition of the modern agricultural complex.

III. RESEARCH METHODOLOGY

Most of the country's agricultural enterprises are almost stagnant in relation to innovative development. Therefore, we are talking about the inefficiency of agricultural production. And there are a lot of inefficient farms. Even if we trace the stages of cultivation and processing of products, at the stage of cultivation is lost about 30 % of production, about 25 – 30 % is lost at the stage of processing, storage and then during transportation of products. Most of the losses are due to natural conditions, but not all.

Much depends on the employees of enterprises. Now Russian agronomists and especially farmers are not ready to work with information technology. The work begins to move only in agricultural holdings that use data from satellites, drones and sensors. For example, we present the application of the system "Agrosargal", which controls the logistics of agricultural machinery by means of sensors 150 farms. It is in these farms that productivity can be increased to 90 – 100 %, and the reduction in production losses is about 45-60 %. Yields can be increased by an average of 12-16 %.

For example, specialists of AgroNote service consider their solutions on the basis of innovative monitoring: according to the remote sensing data accumulated since 1984, they allocate stable intra-field zones of fertility and prepare maps-tasks for fertilizer application for "smart" agricultural machinery. These measures will save 11-16 % of chemicals, increase grain yield and product quality, as well as reduce the amount of pesticides [3].

Currently, the Ministry of agriculture has developed a project of interaction of the Federal system with information systems in 16 regions of the country. Direct measures of state support in rural areas are not provided, and it was decided to develop service centers that will provide manufacturers with the data they need. This will help to reduce the cost of information technology [1].

In 2018, the Ministry of agriculture launched the state information system for seed tracking. This system should

reduce the market of low-quality seed products, which today reaches 40 %, and by strengthening control to improve the quality of seeds.

Among the large enterprises that use digital technologies in their work is the agricultural holding "Rusagro". It handles about one per cent of the country's agricultural land. The agricultural holding has extensive information about the development of all crops, there is information about the work of technology, the properties of hybrids and characteristics of fields, the state of the soil, the applied new technologies and weather conditions in certain areas. The data comes from our own weather stations and weather services, satellite monitoring, control and measurement sensors in the fields.

Analyzing all the collected data, the company makes adjustments to its programs. In "Rusagro" implement solutions with the construction of predictive models based on meteorological data and data on vegetation, then optimized the technology used. Huge reserves have high-quality soil, so the holding is working on algorithms for obtaining improved soil.

The aim of the company is to restore fertility without the use of aggressive technologies and the use of the latest innovations: equipment that does not violate aeration of the soil, precision farming systems that do not lead to the accumulation of pesticides in the final product.

Programmable agricultural machinery, marked on the map places can put in the right place the required amount of chemicals or fertilizers, is on autopilot with the desired characteristics and automatically adapts to environmental conditions. The objectives of the agricultural holding is the modeling and digitalization of processes that will lead to automatic control of machines.

The influence of the human factor in Rusagro is gradually decreasing. For example, the company is testing machine vision technology for quality assessment of sugar beet when making the decision about sending it for recycling or for long-term storage. Such technologies can significantly reduce losses [4].

For example, the company "Outskirts", which in its meat processing plant "Bogorodsky" provides high quality products due to the high level of automation.

The company's information system is based on two main principles: unique coding of each product unit and traceability of the product to batches of raw materials and semi-finished products. Each loaf of sausage or a pack of sausages receives an identifier – Product Individual Code, which is the point of entry into the quality control system and claims management in case of customer feedback.

The company has its own online store, through which passes more than 1.5 thousand orders only for every day. Recently, the company has entered into direct communication with consumers of its products, so the responsibility for the quality of its products has become higher.

If consumers have complaints, then left in the feedback along with PIC you can track the entire path of the product from raw material to the counter and find out the reasons that led to the claims, examined chain to the exact place the error occurred and the names of the responsible technologist.

Registration of production operations is carried out at the place of their execution with the help of mobile devices. In order to find out the cause of deviations in the technological process and to avoid errors in the future, video surveillance is included in the IT-system [2].

The effect of digitalization of the agricultural complex as a whole from the economic side is an increase in the volume of consumption of agricultural products in the country. And this corresponds to the market growth of 4 trillion rubles and the growth of labor productivity several times.

Agriculture was not a business that could attract investors. This is due to the fact that agriculture has a long production cycle, which is subject to natural risks and the possibility of losing a large number of crops. Information technology has always been used only for financial management and for tracking commercial transactions. More recently, Russian farmers began to use digital technologies to monitor crops and other processes in their work [8].

Increased attention to the industry came from the moment when innovative companies together with partners have learned to control the full cycle of crop and livestock production through "smart devices". These are sensors that measure the parameters of the soil, plants, microclimate. It became possible to automate many agricultural processes by creating a digital model of the entire production cycle – scheduling, taking emergency measures to prevent losses in the event of a fixed threat. It became possible to calculate the approximate yield, cost and profit from sales [6].

Agriculture is already becoming a sector with a very intensive data flow. Information comes from a variety of devices - sensors, agricultural equipment, drones, satellites, external systems, partner platforms. All data from different participants of the production chain, collected in one place, allow to obtain information of new quality, to find patterns, to create added value for all participants of the production chain, to apply modern scientific methods of processing and on their basis to make certain decisions that reduce risks, improve the business of manufacturers and customer experience.

The most popular platform currently is the foodnet market. This market is aimed at the production of agricultural products based on modern developments. These are mainly products of organic farming.

Despite the fact that now the Russian market of organic products is only at the stage of formation, its forecasts for 2020 are very comforting and will account for about 15 % of the world market of organic products. This statistics gives the Institute of organic agriculture. But such a prospect can be realized only with the effective support of the state farms, as well as with the use of new technologies.

Organic agriculture is aimed at greening the state of plants, animals, soils, to improve human health. The basic principles of organic farming can be seen in the following:

- the principle of health (improvement of health of soils, animals, plants, human health through the use of environmentally friendly agricultural products without GMOs);
- the principle of ecology (natural state of ecological systems and cycles);

- the principle of justice (relations in the agricultural sector should be based on the environment in General and individual groups of people in particular).

To date, the world market for organic products is leading the United States (45 %), Germany (14 %), France (8 %). In Russia, only a small number of companies are engaged in organic products. We have already said that this is a group of companies of the trademark "Agranta" and the Corporation "Organic". The global movement to promote organic agriculture includes more than 750 organizations from 108 countries and argues that it is a production system that supports soil, ecosystem and people, taking into account local conditions. Organic farming is considered to be a reasonable alternative in the face of increasing climate and environmental degradation. Currently, almost 200 countries use organic farming.

Since the 1990s, the world market for organic agriculture has been growing by 11-14 % annually. Therefore, the Russian market of organic products can develop and grow in the future, having a great potential in land resources, but only with the significant support of the state. So far, according to economic forecasts in the country, its development will not take place soon.

The authors of the program on organic farming - Agency for strategic initiatives pay great attention to the use of advanced technologies and organic farming is considered a promising direction of the future.

The authors of the program calculated the economic effect of the use of artificial intelligence and robotics in the amount of about 25 billion rubles. It is believed that digitalization will eventually become a high-tech business in agriculture. Over time, any process in agriculture will be possible to bring to automation. This, in turn, will reduce waste and increase productivity. With the help of new technologies and developments it will be possible to control the consumption of water and fertilizers. This is especially important if we assume from the statistics that about 50 % of water resources are wasted.

Internet technologies help to obtain information about specific rural areas. The latest developments and programming help to accurately calculate the periods for laying seeds, the amount of fertilizers, help to determine the soil composition and the period of harvest. The temperature control in the premises is carried out. You can also calculate and forecast the harvest scenario.

Digital technologies are becoming an increasingly real process in agriculture. Precision farming programs are becoming paramount in companies that are engaged in IT-technologies.

The goal of every entrepreneur in agriculture is to produce agricultural products at the lowest cost. For this and need new technology in production. Work on the old methods can no longer be due to fierce competition. A modern farmer should have knowledge and skills in predicting his production, should know the preferences of consumers and focus on demand. To do this, not only individual companies have to deal with digitalization, but every farmer must own digital technologies, such as high-tech sensors. And this requires training and education.

Currently, the educational space is growing and expanding due to the development of the digital

environment. Distance education is firmly part of our lives. Of course, there are great opportunities for universities and additional education in the use of digital technologies. At the heart of each enterprise are the tasks of training and developing a strategy for the formation of qualified personnel. In the era of digitalization, education will no longer be the same, and now we see how new information technologies are actively introduced into education, which makes these processes interdependent. As one of the first harbingers of the digital future in the educational system of almost all advanced countries came e-courses, which predict great prospects.

In developed countries, the introduction of IT-technologies allowed farmers to learn advanced technologies. If we consider the experience of Switzerland, the company Nestle has trained ten thousand farmers in agriculture and advanced technologies of conservation.

Digital enterprise provides for the digitalization and integration of vertical processes throughout the enterprise, from product development and procurement to production, logistics and in-service maintenance. Horizontal integration of a digital enterprise goes beyond internal operations to include suppliers, consumers and all key partners throughout the value chain. It uses a variety of technologies, ranging from tracking and control devices to comprehensive planning. All this is done on the basis of an appropriate digital platform and is a digital system of the enterprise.

The digital platform is understood as a set of digital data, models and tools (methods, tools), information and technologically integrated into a single automated functional system designed for qualified management of the target domain with the organization of interaction of stakeholders.

In 2010, there were no more than 20 companies in the field of agricultural production worldwide, which introduced the achievements of scientific and technological progress. Then this process became more active. To attract investment in the agricultural sector can be primarily called the United States, China, Canada.

The process of implementing digital technologies involving not only advanced companies, but also farmers and all agricultural enterprises is a complex process. It is difficult to train farmers to master information technology without the support of the state, as additional financial resources are needed.

In turn, if the farmer receives timely information about the state of crops grown by him – it helps in making the right decision. New technologies can quite accurately analyze the state of certain crops, the state of animals and the environment in General. On the basis of recommendations via the mobile app.

The pilot project of digitalization of agriculture is already in operation and by 2025 it is planned to intensify efforts to expand it throughout the country and for each individual rural enterprise.

Digitalization of processes is relevant not only at the level of individual enterprises. Many industries choose this way of development as the only opportunity to meet the rapidly changing conditions of the world and be competitive. Therefore, the digital transformation of industry, retail, public sector and other spheres is already changing the lives of every person and every company.

IV. SUMMARY

Russian farmers and agronomists now have access to mobile or online applications that, when downloading data about their field (coordinates, area, crop type, past yield), provide accurate recommendations and a sequence of actions taking into account the analysis of many historical and current factors, both on their site and in the external environment, combining data from equipment, sensors, drones, satellites and other external applications. This program helps to determine the best time for planting seeds, what fertilizers should be applied. The program calculates the time of loading and delivery of the goods to the buyer; tracks the temperature in the area of storage and transportation to avoid damage and always deliver fresh products, as well as predicts yields and income and gives advice on improving plant processing in comparison with past performance.

A feature of agriculture in Russia is a high proportion of private farms and farms, for most of which are not available means of mechanization and automation of labor. This in turn leads to poor performance. A low productivity leads to low wages and high unit costs per unit of production. Vertically integrated holdings in agriculture are very small – 0.1 %. They should be the main productive force of the industry and provide the maximum contribution to the GDP of agriculture.

At the same time, large farms have a high level of debt. Thus, in 2016, the total volume of loans to agricultural producers exceeded 1.5 trillion. thus, even if there are mechanisms for subsidizing the interest rate, most of the profits of agricultural producers go to debt service, and not to the introduction of modern technologies.

Therefore, now the key problem of Russian farmers is that at least some technologies become available only to

large and medium-sized businesses. Now not all farmers can use advanced solutions. However, digitalization tools will become cheaper, and this will make their use mass.

It is hoped that in the near future, many Russian farmers will also be able to use the potential of digitalization to achieve their goals, as advanced companies do today.

REFERENCES

- [1] Order of the Government of the Russian Federation of July 28, 2017 No. 1632-R on approval of the program "Digital economy of the Russian Federation" [as of October 15, 2018] <http://www.consultant.ru>, free.
- [2] A.A. Aletdinova, "Innovative development of the agricultural sector on the basis of digitalization and creation of technological platforms," *Innovative journal*, No. 4, pp. 11-15, 2017.
- [3] A.S. Kolomeychenko, "Information support of innovative development of the agroindustrial complex," *Vector of the economy*, No. 4 (10), pp. 20-27, 2017.
- [4] D.A. Kurasova, M. H. Gantamirov, "Problems of development of IP in agriculture of the Russian Federation," *Scientific researches*, No. 2 (13), pp. 55-58, 2017.
- [5] E.I. Lovchikova, N.Ah. First, A.I. Solodovnik, "Digital economy and personnel potential of agroindustrial complex: strategic interrelation and prospects," *Vestnik Orelgau*, No. 5 (68), pp. 55-59, 2017.
- [6] F.I. Litvinov, "Sustainable socio-economic development of agriculture in the conditions of Russia's entry into the era of the digital economy," *Economy and society: modern models of development*, No. 15, pp. 34-38, 2017.
- [7] I.A. Romanenko, N.E. Evdokimova, "Information and analytical system to support the tasks of forecasting the development of regional agro-food systems," In the collection: *Innovative technologies of cultivation of crops in the non-Chernozem region*. Vladimir research Institute of agriculture, pp. 26 -32, 2013.
- [8] R.N. Saitov, "Digital economy in agriculture," *Youth scientific forum: electr. collection of articles on the Mat. X international. stud. science.-prakt. Conf. № 9(10)*. [https://nauchforum.ru/archive/MNF_interdisciplinarity/9\(10\).pdf](https://nauchforum.ru/archive/MNF_interdisciplinarity/9(10).pdf) (date accessed: 04.03.2019)